
ESSENTIAL SOURCES IN THE SCIENTIFIC STUDY OF CONSCIOUSNESS

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To get a sense of fringe experience, we only need to repeat an experiment most of us carried out when we were seven or eight years old: saying the same word over and over again rapidly. After 10 or 20 repetitions, *something* in the experience of the word definitely begins to change. What were unobtrusive overtones of felt meaning begin to disappear, becoming evident in their absence. In these cases we typically say that the repeated word has become a "mere sound" and has "lost its meaning."¹ Even at the level of folk psychology we naturally distinguish a sensory and nonsensory component in experience.

The fringe includes virtually every feeling in consciousness that is not a sensory experience in the narrowest sense. Familiarity is a feeling in the fringe. All expressive feelings that can envelop or fuse with conscious sensations—the sorrowfulness of the willow, the joyfulness of sunshine in spring, the friendliness of a smile—are fringe feelings. Free-floating anxiety, the feeling of causal connection, the sense of "mine-ness" underlying our concept of self—these, too, are fringe feelings—as are intuitions and hunches. The "Aha!" experience of finding the right solution to a problem is a fringe experience (I will call it "rightness"), as is the opposite feeling that something is wrong, out of place, problematic ("wrongness").

Today when people consider the subjective character of consciousness, they often talk about "qualia." The term "qualia" has come to refer to prototypically clear and vivid experiences, experiences that are easily inspected in the focus of attention, and that belong to a specific sensory modality—for example, the experience of a sharp pain or the color red. Unlike qualia in this sense, fringe experiences have no vivid sensory content.² Fringe experiences are indistinct, hazy, diaphanous; they are like pervading field states in consciousness rather than a specific localized point. Unlike qualia, fringe experiences

cannot be grasped and brought into the focus of attention.

William James is now coming back into style. But most of his work on the fringe is still ignored—even though James himself took the fringe to be fundamental for understanding cognition in consciousness. Probably the chief reason that people continue to overlook the fringe is because of its peculiar phenomenology. Any yet there is reason to believe that the investigation of fringe phenomenology will tell us as much about the cognitive operation of consciousness as qualia, perhaps more.

This paper has three related but distinct aims. The first is simply to help bring the topic of the fringe back into cognitive research. The one feature of the fringe that *is* often discussed today is the continuity of consciousness. And yet for James the feeling of continuity plays a subsidiary role in cognition. Continuity is in large part a *consequence* of other and more fundamental aspects of the fringe, as we will see.

The second aim of this paper is to extend James's analysis of the fringe in new ways. To a degree, James goes beyond a simple description of the fringe and begins to analyze it in functional terms, specifying the cognitive role individual fringe experiences play within consciousness and linking fringe phenomenology in general with the structure of neural activity (see Mangan 1991). I have tried to move a step or two further along this path, offering a functional analysis of the fringe that treats it as one part in a much more inclusive cognitive system. Among other things, this means considering the relation of the fringe to nonconscious processing—a line of investigation that James actively resisted.³

The fringe itself is completely conscious. But in some respects the fringe functions as if it were a sort of semipermeable membrane, separating conscious and nonconscious processes and selectively mediating the flow of information between

them. In general, the function of the fringe is to represent huge amounts of nonconscious context information in consciousness in *radically summarized or condensed* form. This is the basis of the relatively specific fringe functions we will examine of metacognitive monitoring and voluntary retrieval.

The fringe is an overlay of many analytically distinct experiences. From a cognitive standpoint, probably the most important single feeling in the fringe is the experience I call rightness. Rightness and its polar opposite, wrongness, appear to be the evaluative foundation of virtually all complex cognitive activity in consciousness—for these experiences represent the most crucial of all cognitive conclusions: Yes/Accept or No/Reject. By linking this analysis to a slight extension of connectionist theory, we open up the possibility of finding specific neural mechanisms in the brain that determine when rightness is to be experienced in consciousness as well as its intensity level. This may have implications far beyond the study of consciousness, because these neural networks, if they do exist, probably also determine global accept/reject evaluations for the (many more) cognitive processes that do *not* feed into consciousness.⁴

We will also go beyond James by trying to explain *why* consciousness has a fringe/focus structure. The vague, diaphanous, indistinct character of fringe experience appears to be the result of a biological adaptation—a trade-off strategy that is all but mandated by the remarkably limited capacity of consciousness to articulate experience. The fringe is apparently a device to radically *condense* context information in consciousness and in a sense *finesse* the limited capacity of consciousness. The fringe makes minimal demands on the overall articulation resources of consciousness, freeing most of these resources for the representation of detailed focal experience. This analysis lets us explain the overall fringe/focus structure of our phenomenology, and it follows the same general lines biol-

ogists use to explain many other aspects of organic structure.

The third aim of this paper is to link up the fringe and experimental research. It is remarkable that some of the most significant lines of evidence for the fringe already emerged during the early years of the cognitive revolution. Ulric Neisser's groundbreaking *Cognitive psychology* (1967) probably contained more findings related to the fringe than any other single work before Mangan 1991. There is also a direct (if forgotten) line of descent from James's analysis of the fringe to the current study of metacognition. The first prominent work on feeling-of-knowing and metacognition is Hart's (1965). His experiments not only produced early evidence for the operation of rightness, but they were based explicitly on James's discussion of the tip-of-the-tongue phenomenon (TOT). For James, a TOT was a prime example of the fringe in operation. The experimental literature on TOT also derives from Hart via Brown and McNeil (1966). Beyond this, more recent literature on various aspects of tacit or implicit cognition (e.g., Marcel 1983; Lewicki 1988; Janowsky, Shimamura, and Squire 1989; Bowers et al. 1990; Weiskrantz 1992) contains much evidence for the fringe, as will be shown.

With a few hints, one could almost deduce the existence of the fringe from these findings. In any case, the notion of the fringe offers a wide-ranging theoretical unification—one that is able to tie together objective empirical findings from many lines of cognitive research and, at the same time, address some of the most intimate and subjective aspects of our conscious life.

James's Phenomenology of the Fringe

Terms and Methodology

Normally, fringe experiences surround and interpenetrate what James calls the "definite sensorial images" in the focus of attention—that

is, qualia in its current sense. For better or worse, James was never one to stick to a single term when ten evocative synonyms were available. He used many other at least roughly equivalent names and phrases for the fringe such as "the free water of consciousness," "feelings of relation and tendency," the "penumbra or halo" of consciousness, "transitive experience," and "vague experience." James's basic contrasting term for fringe experience is clear experience, but he gives clear experience, too, many synonyms such as "substantive experience," "definite sensorial images," and the "nucleus" of consciousness.

James used many different techniques for distinguishing fringe experiences from the sensory contents in the focus of attention. Probably the most recurrent was to look at cases in which the sensory component or nucleus remained the same over time but the overall quality of the experience changed. That which changed was the nonsensory or fringe aspect of the full experience in question. We come to recognize the character of fringe feelings after the fact via a contrast carried out in memory, and so introspection in these cases is indirect. This is how we recognize the fringe sense of meaningfulness that normally envelops the sound of a word by recognizing its absence when we repeat the same word rapidly.

The fringe experience of familiarity also becomes evident by way of contrast. As James says:

What is the strange difference between an experience tasted for the first time and the same experience recognized as familiar, as having been enjoyed before, though we cannot name it or say where or when? (p. 252)⁵

Familiarity is certainly a feeling in consciousness, but it has a very different character from a focal sensory content. The experience of familiarity is diffuse, enveloping; it eludes our introspective grasp. The experience of familiarity can deliver the same message ("encountered before") about an indefinite number of different sensory contents; this is what allows us to distinguish the

feeling of familiarity from the various contents it can envelop over time. But familiarity is only one of the virtually infinite number of possible fringe experiences.

The Stream Metaphor

Few today remember the core point James himself wanted to make with the stream of consciousness metaphor: that consciousness is saturated with fringe experiences.

The Crucial Insight: Feelings of Imminence or Potential Accessibility

"What a thought is, and what it may be developed into, or explained to stand for, and be equivalent to, are two things, not one" (p. 279). This is the axis on which James's phenomenology of the fringe turns. Miss it, and most of what James has to say will be lost. Fringe experiences are *not* simply blurred or unfocused versions of more detailed experiences that have just occurred or are just about to occur. A vague experience is simply itself, just as it happens, just as it seems. We will see that *both phenomenologically and functionally, the fringe is a completely distinct domain of consciousness with a completely distinct cognitive role*. Furthermore, many fringe experiences (e.g., familiarity, rightness) do not even feel as if they have a clear sensory aspect that can be elaborated brought in the focus of attention.

The fringe uses just a few gossamer wisps of experience to create the sense of imminence. At any given moment, far more detailed information is potentially accessible *to* consciousness than, in fact, is actually *in* consciousness. This is the trick that lets consciousness finesse its otherwise severely limited capacity to represent information.

Transitive/Substantive Cycling

The relative proportion of vague to clear experience in consciousness is not constant; it varies

over time, going through a kind of cycle, with the fringe sense of imminence more pronounced in the transition between one clear content and the next.

When discussing fringe experience in its dynamic role, James often employs yet another set of synonyms: "substantive experience" refers to the clear sensory core or nucleus, whereas "transitive experience" refers to the fringe aspects of consciousness which strengthen when they are between one clear experience and the next.

If we take a general view of the wonderful stream of our consciousness, what strikes us first is the different pace of its parts. Like a bird's life, it seems to be made of an alternation of flights and perching. The rhythm of language expresses this, where every thought is expressed in a sentence and every sentence closed by a period. The resting places are usually occupied by sensorial imaginations of some sort whose peculiarity is that they can be held by the mind for an indefinite time, and contemplated without changing; the places of flight are filled with thoughts of relation, the matters contemplated in the periods of relative rest. Let us call the resting places the "substantive parts" and the places of flight the "transitive parts" of the stream of thought. (p. 243)

During the transition from one substantive content to the next, fringe experiences occupy, briefly, a larger portion of consciousness: the clear content that had occupied the focus of attention begins to become a fringe representation, and the clear content that is about to occupy the focus of attention is represented by fringe experience as imminent. Again, it is a fundamental mistake to conflate fringe representations that something was, or is about to be, a clear and delineated content in consciousness, with that clear content.

The Elusive Fringe

In addition to its vague or unarticulated character, fringe experiences are also elusive. By this I mean that even if we do recognize their presence in consciousness and actively try to "grasp"

them (i.e., bring them into the focus of attention), they instantly transform into something else. What had been a vaguely felt presence becomes something entirely different—a clear experience.

It is very difficult, introspectively, to see the transitive parts for what they really are. . . . Let anyone try to cut a thought across in the middle and get a look at its section, he will see how difficult the introspection of the transitive tract is. The rush of thought is so headlong that it almost always brings us up to the conclusion before we can arrest it. Or if our purpose is nimble enough and we do arrest it, it ceases forthwith to be itself. As a snowflake crystal caught in the warm hand is no longer a crystal but a drop, so, instead of catching the feeling of relation moving to its term, we find we have caught some substantive thing, usually the last word we are pronouncing, statically taken, and with its function, tendency and particular meaning quite evaporated. The attempt at introspective analysis in these cases is in fact like seizing a spinning top to catch its motion, or trying to turn up the gas quickly enough to see how the darkness looks. (pp. 243–244)

The *attempt* to grasp a fringe experience gives us instead "some substantive thing." James does not, so far as I know, consider the much broader implications of this for understanding mechanisms of voluntary conscious retrieval. James's point here is to use various examples to show that fringe experiences do exist in their own right, and at the same time explain why standard introspective approaches had ignored them. James could hardly claim to have found a vast realm of experience overlooked by traditional introspective psychology if he did not also explain how the oversight occurred.

Rightness and Wrongness

James offers only a few remarks, made in passing, about feelings of evaluation in the fringe. But what he does say is pregnant and will help us go beyond James to see how the different elements of the fringe work together as a larger cognitive system. James mentions feelings of

evaluation as he points out how we often experience the nonsensory germ of an intention before its sensory content arrives:

How much of [an intention] consists of definite sensorial images, either of words or of things? Hardly anything! Linger, and the words and the things come into the mind; the anticipatory intention, the deviation is no more. But as the words that replace it arrive, it welcomes them successively *and calls them right if they agree with it, and calls them wrong if they do not.* (p. 253, my emphasis)

The most basic and pervasive feelings of relation in consciousness are the signals "right" and "wrong."⁶ In the above passage, as elsewhere, James considers the evaluative relation that obtains between and among different aspects of *experience*, often the overall fit between the totality of a given fringe state and substantive content or nucleus it surrounds. For a fringe may or may not harmonize with its nucleus. In effect, James makes the same point while discussing TOT:

Suppose we try to recall a forgotten name. The state of our consciousness is peculiar. There is a gap therein; but no mere gap. It is a gap that is intensely active. A sort of a wraith of a name is in it, beckoning us in a given direction, making us at moments tingle with the sense of closeness, and then letting us sink back without the longed for term.... If wrong names are proposed to us, this singularly gap acts immediately to negate them. (p. 251)

In a TOT, consciousness seems to attempt to pull in a specific substantive element that, for some reason, does not materialize. The fringe aspects of consciousness stands out more strongly without the normally overpowering substantive content. This "gap" that we feel in consciousness is pure nonsensory experience, pure fringe experience—a kind of structured vacancy that certainly is not void and that certainly seems to be doing cognitive work.

On James's account the fringe delivers very general evaluative signals—feelings that tell us to accept or reject this or that specific sensorial

content as it materializes. Certainly we can all attest that although these yes/no, right/wrong feelings in the fringe have no sensory content, they can be a strongly felt, in their way as strongly felt as the sensory pain of stubbing a toe.

It is odd that James says so little about evaluative signals in consciousness, given that at one point he tells us they are the most important components in the fringe: "*The most important feeling in these fringes ... is the mere feeling of harmony or discord, of a right or a wrong direction in the thought*" (p. 261; my emphasis).

Relation, then, to our topic or interest is constantly felt in the fringe, and particularly the relation of harmony and discord, of furtherance or hindrance of the topic. When the sense of furtherance is there, we are "all right"; with the sense of hindrance we are dissatisfied and perplexed, and cast about us for other thoughts. Now *any* thought the quality of whose fringe lets us feel ourselves "all right" is an acceptable member of our thinking, whatever kind of thought it may otherwise be. (p. 259; James's emphasis)

For James, then, the feelings of rightness and wrongness are among the most pervasive feelings in consciousness, able to indicate the success or failure of innumerable different kinds of ongoing cognitive activity. Again, James uses a variety of evocative terms for the same basic facts of experience, and this gives us some idea of the many cognitive domains they invest. He also calls the sense of "right direction" the "feeling of rational sequence" and "dynamic meaning." And dynamic meaning "is usually reduced to the bare fringe we have described of felt stability or unfitness to the context and conclusion" (p. 265).

Here is a final example, one that shows both how strong the experience of rightness or wrongness can be and how completely distinct these experiences are from the sensory content with which they merge. Read the entire paragraph through at normal speed:

A newspaper is better than a magazine. A seashore is a better place than the street. At first it is better to run

than to walk. You may have to try several times. It takes some skill but it is easy to learn. Even young children can enjoy it. Once successful, complications are minimal. Birds seldom get too close. Rain, however, soaks in very fast. Too many people doing the same thing can also cause problems. One needs lots of room. If there are no complications it can be very peaceful. A rock will serve as an anchor. If things break loose from it, however, you will not get a second chance. (Klein 1981)

When most people read this for the first time, it makes no sense. No thread of meaning connects one sentence with the next. The objective fact that our organism doesn't understand this paragraph is represented in consciousness by a certain kind of subjective fringe feeling—a jagged, disjoint sense of “wrong” movement from sentence to sentence. And even when the fringe feeling of wrongness is intense, it is still diffuse as it seethes around and through the purely sensory aspect of the experience—the look of the words or the sound they make. Note that although fringe experiences in the average are probably less intense than focal experiences, this is by no means always the case. A vague experience can be extremely intense. Vagueness and intensity fall on different phenomenological dimensions. Fringe and focal experience can both vary over the full range of the intensity continuum.

Now the reader should look again at the seemingly disjoint paragraph above. But first let me remind him or her of the word “kite.” Now the clouds will lift, instantly. *Before* rereading the paragraph, the reader will experience a strong, diffuse sense of rightness flooding consciousness. Here rightness functions as a feeling of imminence: we feel with certainty that *when* we reread the paragraph, it will make perfect sense, that each sentence will fit together into a larger, integrated, meaningful whole. And during the actual rereading this does turn out to be the case; as we move from sentence to sentence, the fringe feeling is of integration, coherence, right fit among all the individual parts. Here rightness

constitutes what James calls our sense of “rational sequence” or “dynamic meaning.”

Explaining the Fringe and Its Functions

It should now be evident that fringe feelings exist, that they are distinct from sensory contents, and that they play a role in conscious cognition. On this basis, we can now move the analysis of the fringe further into new ground, and to a degree explain *why* our phenomenology has the character that it does. This will apply basic principles of biological explanation to consciousness. My most inclusive point is this: the phenomenology of the fringe is an adaptive response to the limited capacity of consciousness to articulate experience.

To avoid confusion, the reader should always keep one point in mind: Fringe and focal experiences differ even more radically in their respective cognitive *functions* than they do in their *phenomenology*. As we have seen, fringe and focal experiences normally merge seamlessly in the flow of consciousness and often can only be distinguished indirectly. Experiences in the fringe or the focus of consciousness differ only by degree along a single phenomenological dimension that I will call the high articulation/low articulation continuum. (This gives us a more precise way to characterize the difference between clear and vague experience as James uses these terms.) Functionally, however, fringe and focus differ in many ways, and they differ hugely.

Context Representation, Monitoring, and Voluntary Retrieval

Overall, the fringe functions to represent context information in consciousness, to monitor the flow of information as it moves through consciousness, and to mediate the willful retrieval of nonconscious information into consciousness. These functions are closely related and they can all be found, if we look carefully, in James's analysis of the fringe. But James himself does not

isolate them, and in the case of voluntary retrieval, he apparently misses a crucial implication of his own findings.

James seems to recognize that feelings of relation and tendency, of meaning, of temporal connection with the past and the expected future all involve context information. We saw James say above that fringe experiences contain feelings of "stability or unfitness to the context and conclusion."⁷ To understand the nature of context information is arguably the main challenge for cognitive research today. The standard assumption is that contextual processes operate exclusively at the nonconscious level. Yet if James is right, *the fringe represents some context information directly in consciousness*, albeit in an extremely condensed form.

The fringe experiences of rightness and wrongness are the most inclusive of all evaluative signals in consciousness. In functional terms, they signal the degree to which the other contents of consciousness (in both the fringe and focus) are or are not compatible with a vast amount of relevant nonconscious context information.

Rightness and wrongness operate in virtually all cognitive domains. In monitoring, when the overall flow of contents (what I will call at times the "trajectory" of consciousness) is going well, we feel rightness; when the flow or trajectory is going ill, we feel wrongness. These feelings vary in intensity and thereby signal innumerable degrees of cognitive success or failure in consciousness. These fringe feelings are able to represent as imminent the future success or failure of a trajectory. In trying to solve, say, a demanding math problem, rightness/wrongness gives us the sense of more or less promising directions long before we have the actual solution in hand.

Rightness considered in its monitoring function (i.e., as representing the positive evaluation of the overall direction or trajectory of experience occurring over at least a few substantive/transitive cycles) envelops the string of individual

nuclei as they move through consciousness with the feeling of smooth, integrated flow. This functions as our basal "all is well" signal, indicating that our potential capacity to handle the material in question is strong. Wrongness, of course, represents the opposite message in consciousness, that potential cognitive capacity is weak.

When we read the kite-flying paragraph for the first time, the feeling of wrongness indicated that if we were called on to handle this material (say, answer questions about the subject of the paragraph), we would have serious cognitive problems. On the other hand, the sense of smooth, coherent movement from sentence to sentence signals consciousness that we do have the capacity to deal with the paragraph. The entire genre of nonsense literature (e.g., Lewis Carroll's "Jabberwocky") rests on the fact that our general signal of cognitive coherence, the feeling of rightness in its monitoring function, can be tricked in various ways to envelop verbal material that, when analyzed substantively, makes no literal sense.

Rightness/wrongness monitoring is ubiquitous, providing a generalized and subtly shifting evaluative ground over which virtually all specific cognitive activity in consciousness plays—in guiding the trajectory of complex problem solving, for example, or giving us a sense of how well a conversation is conforming to, or violating, its many tacit constraints (social, grammatical, syntactical, etc.). In general, this means that much of what people call the continuity of consciousness—the sense of smooth transition from content to content—derives from rightness in its monitoring function. In aesthetic experience, maximizing the feeling of rightness is an end in itself.⁸

In cases ranging from aesthetic "ineffability" to feeling-of-knowing experiments and in some instances of blindsight, people are often unable to identify the precise phenomenological basis for their judgments, even though they can make these judgments with consistency and, often, with conviction. To explain this capacity, people talk

about "gut feelings," "just knowing," hunches, and intuitions. By identifying the fringe and its component experience of rightness, we may be able to demystify the notion of intuition. From the standpoint of consciousness, *intuition is simply a conspicuous, if heretofore puzzling, example of fringe feelings doing cognitive work in the absence of a sensory content*. We can link intuition to an inclusive cognitive system, one that operates in virtually all cases of complex conscious cognition. As discussed in the section "Contemporary Research and the Fringe," isolating the experience of rightness may open up a new window on neural processing, a window that may, among other things, let us see how our organism can determine the likely direction in which a solution lies *before* the solution is found.

In general, if we consider the operation of consciousness over time, rightness works as a feedback device, guiding the local and specific activity of focal attention toward increasing conformity with antecedent and unconsciously encoded context demands. This process leads to a reciprocal interaction between conscious and unconscious processing: the process of detailed conscious analysis will usually change the context, and this in turn will change the evaluative signal that rightness manifests, and so on.

In addition to context representation and monitoring, the fringe is also part of the mechanism that apparently allows consciousness to actively retrieve nonconscious information into focal attention. Again the tip-of-the-tongue example is a useful case. When we expect the right word to come into consciousness and it doesn't, we experience a kind of tantalizing vacancy. We grasp at this vacancy almost as if we were trying to squeeze a specific content out of it. When the right word doesn't manifest, we feel what James calls the "wraith" of the word: the sense of the word is as a *potential* sensory content but without the actual sensory content. Our frustration in such cases *presupposes* that normally mental grasping of this sort *will* yield the right word quickly and effortlessly.

Cognitive processes are not designed to be evident but to be useful. Normally, fringe retrieval is so fast and error free that we overlook it. Only when the system malfunctions, and the ghost of the word does not incarnate, do we begin to see that the act of *attempting* to focus on an aspect of the fringe is a voluntary "call" command that initiates the conversion of information implied by the fringe into detailed experience in the nucleus.

Explaining Fringe Phenomenology

Before taking up the general question of why consciousness has a fringe/focus structure. Let me first try to explain two relatively specific features of fringe phenomenology that James simply described—substantive/transitive cycling and the elusive or ungraspable quality of fringe experiences.

So far as I know, James did not extrapolate from the atypical case of a tip-of-the-tongue experience to typical cases of voluntary retrieval into consciousness. But as we saw above, James's account certainly implies that a TOT is just an instance of normal retrieval that has become stuck in midcycle, and that the fringe is an important link in the process that normally "calls" new information into consciousness. The command that actually triggers this call being the *attempt* to focus attention on the fringe or, more precisely, to focus on that aspect of the fringe that implies the detailed information to be retrieved. The vague fringe feeling that something is imminent or *potentially* accessible for focal inspection is a very different experience from the subsequent representation of that something in the focus of attention.

If so, we can explain the elusive, ungraspable character of fringe experience as a *consequence of its call function*. This is the "design" reason fringe experiences thwart attempts at direct (i.e., focal) introspection. The cognitive purpose of focusing on a vague experience in the fringe is not to make *that* experience a stable entity in at-

tention, but to bring a far more articulated (informative) experience into focal inspection. If the attempt to attend to fringe experiences *themselves* simply brought them unchanged into the focus of attention, the ability of the fringe to execute its retrieval function would be severely undercut. We will return to this point with the "menu bar" analogy for the fringe below.

It is primarily the call function of the fringe that creates the impression that fringe experiences are "nothing but" fleeting, preliminary forms of clear experiences. In the section "Contemporary Research and the Fringe," I show that this is probably the chief reason that researchers today recognize many aspects of fringe phenomenology but still miss the overall cognitive role fringe experiences play in conscious cognition.

We can explain transitive/substantive cycling between vague and clear experience as the macro consequence of a series of individual acts of retrieval. In each case of voluntary retrieval, the attempt to focus attention on the fringe produces a brief pulse of transitive "flight" before the retrieved articulated content constitutes a point of "rest" in attention. In other words, transitive states are (in part) the result of a series of acts of retrieval, substantive states are the relatively stable experiences that result from this retrieval.

To turn now to perhaps the most inclusive question: Why should consciousness have a fringe/focus structure in the first place? Can we generate a scientifically plausible hypothesis able to account for the overall phenomenological character of the fringe/focus structure of consciousness beyond its elusive quality? In other words, can we go beyond a *description* of fringe phenomenology as vague, ill defined, and diaphanous to an *explanation* of this phenomenology?

First a conceptual point. In order to explain why a biological entity (say, our heart) is the way it is, we identify the various factors that have shaped it. These factors fall into at least two categories: (1) the function or functions that the entity in question executes and (2) the par-

ticular systemic factors that have *constrained* or otherwise *limited* the entity's ability to execute these functions. In general, it is only after we have been able to identify both general functions *and* the particular systemic constraints on a biological system or subsystem that we are able to move toward a full explanation of its *particular* character—that is, as the joint outcome of particular constraints and functional demands.

For example, to explain why our heart has the particular character it has, we need to know that it functions as a pump. But in itself this abstract functional information is hardly enough to enable us to explain why the human heart is constituted as it is. We also need to understand the various specific constraints to which the heart had adapted in its coevolution with our overall physiological system: for example, constraints on its design imposed by the nature of muscle contraction, the need to maintain blood pressure within certain limits, the particular viscosity of the blood and the need to pump blood without damaging it, and so on.

We can apply the same general method of biological explanation to the fringe. We have already reviewed some of the fringe's cognitive functions—context representation, monitoring, voluntary retrieval. Let us now consider one of the apparent constraints on consciousness that, co-evolving with its functions, may have produced the fringe/focus structure in our phenomenology.

At any given moment, consciousness is extremely limited or "narrow." This has been a recurring theme since the dawn of the cognitive revolution. Standard examples include our inability to attend to more than a single source of novel input such as a conversation at any given moment, and our inability to apprehend more than a few perceptual objects simultaneously. This limit on consciousness can be expressed in various ways, and some of this research will be reviewed in the next section.

Here I will consider how we can capture this limitation in subjective, phenomenological

terms. I propose that the most inclusive way to describe the subjective limitation on consciousness is as a limit on its *articulation or resolution* capacity. In other words, consciousness is only able to resolve itself to a certain level of detail at any given moment.

This is nothing more than a slight generalization from George Miller's (1956) classic observation that the capacity of consciousness is limited to about seven distinct "chunks" of experience. One virtue of Miller's formulation is that the concept of a chunk applies naturally to both our subjective phenomenology and to objective empirical findings about the limitations on conscious processing. But in experience a single chunk itself as some residual articulation, notably texture. And the blurred quality of peripheral experience, as well as the nonsensory aspects of the fringe are also part of our experience but are not handled by the notion of a delineated chunk in the focus of attention.

The notion of articulation, then, is able to include that of chunking, but it goes beyond chunking by capturing the more general character phenomenological detail that we find in the experience of texture and the blurred quality of peripheral experience. The general notion of articulation capacity subsumes experience in or out of focal attention, chunked or not chunked.

We can then formalize the subjective *limitation* under which consciousness labors as a limitation of its articulation capacity. Put in these terms, it is evident that the fringe uses only a small amount the total articulation resources of consciousness. Most of consciousness's limited resources are devoted to articulating detailed entities in focal attention. The vague, amorphous, and diaphanous character of fringe experience places the fringe very much on the low end of the articulation continuum.

Intersecting this way to formalize our phenomenology with the functions the fringe executes, we get the following picture: The fringe works, in effect, to radically *condense* information in consciousness. By representing infor-

mation indistinctly, the fringe frees up more of consciousness's resources to articulate the contents in the focus of attention. It is inefficient to burden consciousness with detailed information if simply informing it of a summary conclusion will do.

The fringe/focus structure of consciousness therefore appears to be the result of a trade-off strategy between the need to articulate information in detail, and the need to represent the larger context in which that information is embedded. To maximize the efficiency of conscious cognition, a fringe experience need only be distinct enough to deliver its message, and thereby minimally impinge on consciousness's articulation capacity. The current equilibrium between the allocation of limited articulation capacity to focus and fringe is presumably the result of a long biocognitive evolution.

The fringe, then, responds to a fundamental cognitive paradox: On one hand, consciousness is extremely limited in its representational capacity, however conceived. On the other hand, consciousness interfaces with extremely complex bodies of nonconscious information that transcend consciousness's capacity for direct representation by many orders of magnitude. Consciousness cannot possibly represent in detail anything distantly approaching the totality of information that bears on its cognitive activity. The fringe is able to finesse the limited capacity of consciousness by using just a few wisps of vague experience to represent summary facts about states of nonconscious information that are otherwise far too complex for direct conscious representation.

The Fringe as Menu Bar

There is a useful analogy (if not pressed too far) between the fringe and the user interface devices of menu and status bars found on many computer screens. The analogy applies to passive display of information as well as to its active retrieval. Both consciousness and a CRT labor

under a basic articulation limitation, and both employ similar trade-off strategies to circumvent this limitation.

Over time, a virtual infinity of different images can occupy a computer screen, as they can occupy consciousness. But at any given moment, there is only so much resolution or articulation capacity available for representation in either medium.⁹ The minimum grain size is fixed. In the case of a computer screen, resolution is limited by the size and number of pixels built into the screen. The menu bar works to finesse the pixel limitation, because it indicates the existence of massive amounts of information not actually displayed on the screen but represented as *potentially* available if needed.

Menu bars (and status bars) come at a cost. The pixels devoted to the display of peripheral information cannot at the same time articulate the immediate task at hand that occupies most of the screen. But while peripheral displays reduce the maximum resolution capacity available for the main display, they allow, in compensation, for the representation of relevant "context" information, albeit in radically summarized form. For a standard word-processing program, these include simple formatting information, the document page number, the "help," and "view" boxes, and so on.

The second point of analogy between a computer screen and the structure of consciousness should help us see why fringe experience is so elusive—why, when we attempt to focus on fringe experience, a very different experience actually manifests in the focus of attention.

What is the standard command we use to call detailed information to the screen, information that is otherwise only represented implicitly by a menu bar? We simply move the cursor to the relevant box and click the mouse. This move-and-click procedure is a crucial link in the process that converts potential off-screen information into an actual on-screen representation. The direct analogy to consciousness is, of course,

that when we attempt to attend to a vague experience in the fringe, the normal outcome is the presence of articulated information in the focus of attention. Why does the fringe refuse to itself come into the focus? For the same reason, by analogy, that menu bars don't themselves occupy the center of the screen when we click them. The retrieval function of the icon would thereby cease.

One point in which this analogy breaks down is that each pixel on a CRT screen is the same size, and though small, icons are still displayed with some clarity on the screen. The vague, diaphanous character of the fringe is, as it were, created by "fat" pixels (Mangan 1993c). In this regard, consciousness has something like the structure of the receptive fields in the eye; the "pixels" of consciousness become larger and larger the further they are from the focus of attention.

Contemporary Research and the Fringe

The notion of the fringe can be used to link up many findings in the current cognitive literature; this linkage gives empirical support to the phenomenological and theoretical analysis proposed so far. At the same time, this linkage brings out an underlying connection among a number of findings in metacognition, the limitations of conscious processing, and the phenomenology present or absent in various dissociations, among other areas.

Aspects of fringe phenomenology have already been detected in current cognitive research. But these feelings have been interpreted as simply a fuzzy or preliminary form of clear experiences, thus missing much of the fringe's unique functional role in conscious cognition. The chief mistake is what I will call the "fleet-iness fallacy"—that fringe experiences do not differ from sensory experience in the focus of attention, except that fringe experiences come and go quickly and occur in the periphery.

General Anticipations of the Fringe

The extreme "narrowness" or the limited capacity of consciousness is of course one of the earliest findings of the cognitive revolution. It remains a fundamental orchestrating fact for the empirical study of consciousness, as Baars (1988) has shown in some detail. The cognitive revolution virtually began with the dichotic listening experiments of Cherry (1953) and Broadbent (1954), who showed that consciousness can usually handle only one complex stream of novel information at a time—the so-called cocktail party effect. And within a single stream, consciousness labors under the further restriction of its chunking limits, first set out in the contemporary literature in Miller's (1956) now classic paper, "The magical number seven, plus or minus two" (chap. 23, this volume).

To handle these findings, researchers also appeal to the explanatory principle used in the previous section—the efficient allocation of a scarce cognitive resource. Broadbent (1958) argued that the single source limitation could be explained as an efficient way to husband limited processing capacity. Miller (1956, 1962) explained the operations of packing and unpacking as a cognitive strategy that worked, over time, to circumvent the chunking limit. Early in his career, Neisser (1967) held that the distinction between preattentive processes and focal attention was the result of a trade-off of limited cognitive resources, with the narrowness and selectivity of focal attention "simply an allotment of analyzing mechanisms to a limited region of the field" (p. 89).

Neisser's early work on preattentive processes probably came the closest to rediscovering the fringe experimentally. According to Neisser (who tried to avoid the term "consciousness"; see Mandler this volume) the preattentive realm contains "shadowy and impalpable experiences" (p. 303) that represent "crude and global properties" (p. 301) of the articulated contents in the focus of attention. To a degree, preattentive

processes work as a context in which attentive acts take place: "Attentive acts are carried out in the context of the more global properties already carried out at the preattentive level" (p. 90).

But there are significant differences between the fringe and Neisser's notion of preattention. He uses "preattention" to refer to both conscious and unconscious elements. The term refers indiscriminately to vague, inarticulate, and peripheral experiences on the one hand, and to completely unconscious, extremely complex, and parallel processes on the other. And his main interest in preattention is on preliminary figural segmentation, not on the representation of context information in consciousness; nor does he consider the role of "preattentive" experience in voluntary acts of retrieval. Nor does Neisser take the elusive aspect of preattentive experience to be a positive structural characteristic in its own right but rather explains it as the result of its supposedly fleeting and preliminary character.

Another experimental approach to the fringe (if taken as James's sense of directly felt significance or meaning) is to recognize it by contrast when it is relatively absent. After "semantic satiation" a rapidly repeated word will lose its cognitive savor; we naturally say a word in this case has "lost its meaning." The effect is familiar to most children. It is quite amenable to experiment, and it has been called since Severance and Washburn (1907) a "lapse of meaning." This sort of meaning lapse is a completely introspective phenomenon, but its experimental manipulation yields consistent results. So, for example, Wertheimer (1958) reported that image related words retain their feeling of meaning longer than abstract words.

Crick and Koch (1990), coming from a very different theoretical direction, develop a notion of "working awareness," which they feel corresponds roughly to a "spotlight of attention" model. But they suspect that, by itself, a clearly defined content may not be sufficient to capture the reality of conscious experience:

Can a spotlight of attention, moving over the visual field from one "salient" location to the next, explain the perceptual richness of our [conscious] environment? Would such a mechanism not lead to a sort of tunnel vision? ... We suggest very tentatively that this richness may be mediated by another form of awareness that is very transient. ... (p. 272)

Again we find research groping toward fringe phenomena but restricted by the presumption that the phenomenological character of these experiences is simply a consequence of the rapidity of its occurrence.

The connectionists have also tried to explain vague experiences. For Rumelhart et al. (1986), a stable content in consciousness as a fully settled or "relaxed" parallel network. However, if "the relaxation process is especially slow, consciousness will be the time average over a dynamically changing set of patterns and thus would be expected to lead to 'fuzzy' or unclear impressions" (p. 39). Here again vague experiences are presumed to have no cognitive function. They are explained as artifacts produced by many overlapping patterns, each one of which could also occupy consciousness in clear form.

A far more sophisticated account of (in effect) fringe mechanisms is offered by Rock and Gutman (1981). They give us what I believe is the single best experimentally based account that, in effect, distinguishes the fringe's ability to (1) signal the *availability* of detailed conscious information and (2) mediate the retrieval of that information into consciousness. These are two related but very different cognitive functions, availability being signaled far more often than the occurrence of actual retrieval. Rock and Gutman point out that what they call "inattentive" experience (this term, by the way, avoids the conscious/nonconscious confound in "pre-attentive") provides functional information in consciousness that is not a specific, identifiable form or object. The experimental situation is arranged so that subjects viewing stimuli of two superimposed figures (say, a tree and a house) will only attend to one of them. Nevertheless,

subjects are still able to report some general information about the nonattended figure, for instance, that it was red and had curvy lines.

From findings of this sort, Rock and Gutman derive a fundamental conclusion

In daily life ... [when] we are not attending to a pattern at which we are looking, there is the distinct impression nevertheless that something is there and has certain phenomenal characteristics. ... By virtue of the iconic representation, we as observers recognize that the *potential* to transmute this impression is there. (their emphasis)

Information experienced "inattentively" is still conscious, although it lacks the overall specifiable organization we find in an object in the focus of attention. Inattentive experience serves two crucial functions—it implies that detailed information is available *if* attention were to be directed toward it, and provides a target toward which attention can be focused in order to actually bring the detailed information into consciousness.

Rightness

Under various guises, some recognition of the feeling of rightness can also be found in the cognitive literature. But for the most part, these remain veiled. Perhaps because Neisser (1967) did recognize a kind of proto-fringe, he was also able to move closer than most to recognizing monitoring and control experiences. Neisser thought he had isolated a preattentive feeling of "familiarity," and for the moment we will use this term to explain his findings as he did. But we will see that in fact Neisser found experimental evidence of rightness and not familiarity.

Familiarity is treated as a preattentive experience (p. 97), and Neisser asserts that the feeling of familiarity *by itself* can be a datum in target search experiments. No experience of a specific content is necessary. Neisser reports that, on occasion, subjects will be able to recognize that one of a possible set of prespecified targets is present

in an array of other letters (e.g., either the letter "D" or "W") without being able to say *which* target was present (p. 99). This finding can be interpreted as a sort of dissociation of the feeling of "familiarity" from a specific content. The feeling is taken to be a sufficient datum for subjects to perform the target search task, even when the specific "familiar" content is not experienced. If we look closely at Neisser's experiment, it seems that it was rightness, and not familiarity, that allowed subjects to know that a target letter was present without knowing what specific target it was. For Neisser's target search experiments did not manipulate familiarity levels. Subjects were to respond as quickly as possible when the designated target was present (i.e., to the "right" target).

Rightness and familiarity are at least as functionally distinct as they are phenomenologically distinct. This point is crucial, but rarely made. One of the few to note the difference between the two is Walter Kintch (1970): "Obviously, 'appropriateness within a given context' as well as 'perceived oldness' may serve as the basic datum for a subject's decision" in some recognition tasks (p. 276). We can feel strongly that something is right, even if it is unfamiliar—for example, when we recognize the solution to a math problem for the first time. Or when Archimedes discovered the principle of specific gravity, his "Eureka" hailed the recognition of the *right*, but absolutely *unfamiliar*, solution. And who knows how many far more familiar facts Archimedes considered and judged to be wrong before he hit on his discovery.

In the study of cognition, rightness is far more important than familiarity, even though rightness receives far less consideration. Survival depends on finding the right response, which may or may not be the familiar response. Especially for the study of consciousness, rightness and not familiarity is the crucial datum. Consciousness generally deals with novel information, familiar information tending to leave consciousness via habituation (Baars 1988).

To feel we have the right solution is to feel that we know the solution. There is now a growing literature on the feeling of knowing, but apparently lingering behaviorist prejudices are still at work. For even when the phenomenon is given the name "feeling of knowing" (FOK), virtually no attempt is made to work out the precise phenomenological character of the feeling. This is especially ironic, given that FOK research grows directly from the experimental investigation of TOT; the original paper by Hart (1965) makes explicit reference to James's discussion of TOT. And as we saw, the heart of a TOT for James is the sense that the *right* answer is imminent. The phenomenological datum in a FOK is, I would maintain, rightness.

Typically, a feeling of knowing experiment elicits TOTs by asking questions like "What is the capital of Vermont?" or "Name the Union general who was in command at the battle of Gettysburg." When a TOT occurs, subjects estimate the likelihood that they know the right answer, which produces a FOK measure. Typically, subjects respond well above chance, and among the most interesting TOT/FOK findings is that the strength of the feeling of knowing judgment is positively correlated with the amount of time a subject spends searching for an inaccessible memory (Nelson, Gerler, and Narens 1984). The finding that the FOK influences search time is of some importance, because it is evidence that the design and operation of consciousness itself presupposes its functional efficacy, as does the fringe structure generally. Nelson, Gerler, and Narens further note that for Korsakoff's syndrome amnesiacs, search times are very short, which implies that the disruption in the FOK system may also contribute to retrieval failure in this type of amnesia. Janowsky, Shimamura, and Squire (1989) also found low feeling of knowing for Korsakoff's amnesiacs, but not for non-Korsakoff amnesiacs, which suggests that the FOK deficit is associated with pathology of the frontal lobe.

To the degree that the FOK and TOT literature is concerned with the *feeling* of knowing, we again encounter another version of the fleetingness hypothesis. In this case, the presumption that the specific word is somehow coming into and then out of consciousness too quickly to be recognized directly. The possibility of a generalized control experience of rightness—a signal of (potential or actual) context-fit—in other words, a recurring experiential component in common to TOT and FOK—is overlooked. So Brown and McNeill (1966), in one of the classic studies of TOT, offer this interpretation:

We know from the Sperling phenomenon . . . that people can have fleeting access to many details in visual memory that they cannot retrieve a fraction of a second later. . . . There are other sources of support for the idea of fleeting conscious events. In the tip-of-the-tongue phenomenon people often report a fleeting conscious image of the missing word "going by too quickly to grasp." Often we are sure that the momentary image *was* the missing word, and indeed if people in such a state are presented with the correct word, *they can recognize it very quickly and distinguish it from incorrect words*, suggesting that the fleeting conscious "flash" was indeed accurate. (my emphasis)

There are many difficulties with this analysis, and Brown and McNeill indirectly note the chief one themselves but without seeing its import: the crucial datum is the evaluative recognition that the *right* configuration is potentially available, or now manifest, in focal attention. Certainly the general evaluation of right-fit must be made at some cognitive level, and this evaluation is something over and above the specific word taken by itself, be it represented inside or outside consciousness. The heart of a TOT is the *recognition of rightness*, and that recognition is antecedently specified by the particular context, which is of course largely unconscious at any given moment. We all know that occasionally a TOT can last for quite a few, sometimes agonized, seconds, plenty of time to introspectively recognize the specific content—if that were really the heart of the process. *All fleeting experiences*

may be vague, but not all vague experiences are fleeting. Given that a TOT can be relatively long-lasting, I do not see how we can explain its vague character by an appeal to fleetingness alone.

The subliminal perception literature also yields evidence of rightness, and here the fringe aspect of the experience lets us demystify the notion of intuition, in which we have a hunch. So Marcel (1983) remarks on the phenomenon of "gut feelings." In his unconscious priming experiments, one effect was most significant on so-called passive subjects, who, Marcel reports, were more inclined to select (unconsciously primed) words "which 'felt' right" even though they had no conscious criterion for their judgment and could not explain it (p. 204). But here, as I suspect in so many other cases of tacit or implicit cognition, we would seem to have behavior mediated by fringe experience dissociated from a sensory content that would normally occupy the focus of attention.

There is a lingering puzzle about what it is that can guide subjects to recognize that something is right, when they are unable to identify any specific criterion for their judgment. So Weiskrantz (1992) wonders how "one can deal quantitatively with the phenomenon of 'switched' or 'gut' awareness? For example G. Y., a blindsight subject, sometimes says (but this is not true of all blindsight nor G. Y., under all conditions) that he 'knows' that a stimulus has occurred, but insists that he definitely does not 'see'." Here again, simply having right/wrong information in the fringe is by itself quite sufficient for successfully performing blindsight tasks; and subjects do at times report correlative experiences of "just knowing."

Although the situation is complex, and anomalies abound, it is worth noting that an evaluative signaling system in the fringe bears an intriguing relation to an analysis of pathological states of consciousness made by D. L. Schacter (1990). Certain amnesiacs are unaware of information that they nevertheless use implicitly; those afflicted with anosognosia are unaware of

a cognitive or physical deficit. Schacter suspects that these two kinds of "unawareness" are quite different and need to be accounted for. The implicit knowledge/anosognosia contrast does seem to reflect a cognitive distinction in consciousness. Some amnesiacs with only implicit knowledge have apparently lost the ability to feel retrieval accessibility over a certain cognitive domain, and in consequence the "target" experience toward which attention would otherwise focus is gone. Similarly, in anosognosia, the pathological inability to feel wrongness in a given domain would interfere with the conscious recognition of deficits and, at the same time, remove the natural target used to call detailed information about a deficit into consciousness.

If fringe experience is distinct from focal attention and the fringe itself is able to manifest distinguishable component experiences like rightness and familiarity, it should be possible to find cases where these cognitive elements do not operate in their normal, integrated fashion, but are disrupted by neurological malfunctions, or can be teased apart experimentally. If the analysis so far is correct, we should expect to find at least some cases where fringe components operate in the absence of focal consciousness and, conversely, where focal consciousness can occur in the absence of the context information normally encoded in the fringe.

Connectionism and Rightness

Let us return to Weiskrantz's question about how to deal quantitatively with gut feelings and the like. Using connectionism, we *can* attempt to quantify conscious intuitions (and the more explicit serial processes which build on them) by modeling, on a computer, versions of the non-conscious/conscious process that produces these feelings. It would seem that the most important of these feelings is rightness, as the most fundamental positive evaluative component of the fringe, and that rightness can be modeled by goodness-of-fit.

Remember the basic structural limitation on consciousness/nonconscious interaction: If consciousness does perform the cognitive functions it appears to, it must somehow take into account vast amounts of unconscious information that it cannot itself contain; the articulation limitations of consciousness make detailed representation of context information impossible. Rightness represents, in consciousness, perhaps the single most important mechanism controlling conscious/nonconscious interaction: rightness would seem to represent the degree to which an explicit content in consciousness is compatible with its vast unconscious context; rightness links these two cognitive subsystems into a constant and reciprocal interaction.

If the last 30 years of cognitive research have taught us anything, it is that the structure of unconscious context information is massively parallel and distributed; far more like a connectionist network than any serial model currently available. Hopfield's (1982) discovery of goodness-of-fit (see Rumelhart et al. 1986 for a technical discussion of goodness-of-fit) shows that in many cases it is possible to condense into a single metric or index the level of global coherence resulting from an immense number of mutually interacting, neuronlike nodes. And if the connectionist model of nonconscious processing is roughly correct, we can simulate it, to a degree, on a computer, using goodness-of-fit as the interacting link between parallel (non-conscious) and serial (focal attentive) aspects.

Rightness, in consciousness, does seem to behave like a goodness-of-fit metric: that is, it does seem to signal the degree to which a given conscious content is compatible with its parallel and distributed nonconscious context. I believe I have shown that many lines of evidence and theory indicate that the feeling of rightness exists, that it is a distinct entity, and that it is not to be confused with any focal content in consciousness. Rightness signals a coherence relation between *whatever* content may occupy consciousness and *whatever* nonconscious con-

text the content is embedded in. Ignoring habituation, as the content in consciousness becomes more integrated with its (presumably) parallel and distributed nonconscious context, the rightness "metric" should increase in intensity.

We would expect this process, for example, to be evident in early stages of problem solving. Equating rightness with a goodness-of-fit metric, then, gives us a coherent picture of how "hunches" and "intuitions" work at both the conscious and nonconscious level. Rightness is able to guide conscious activity before any clear content has appeared as an explicit evaluative criterion. The findings of Bowers et al. (1990) illustrate just such a process: In the context of discovery:

tacit perception of coherence guided Ss gradually to an explicit representation ... in the form of a hunch or hypotheses. Clues to coherence may automatically activate the problem solvers relevant mnemonic and semantic networks, and eventually the level of patterned activation is sufficient to cross a threshold of consciousness. At this point it represents a hunch or hypothesis. (p. 72)

See McGovern 1993 for an extended discussion of this point.

From the standpoint of current connectionist theory, however, there is a serious problem with my analysis to this point. In their present form, networks do not themselves "compute" goodness-of-fit in order to settle into a stable, maximum goodness interpretation. An actual goodness-of-fit computation is carried out for secondary, descriptive purposes, and uses a standard sequential summation. The computation of the goodness-of-fit of a network is *not*, at the moment, itself carried out by a network.

But because, as I believe I have shown, there is strong reason to hold that rightness exists, we can assume that rightness must be produced somehow by our cognitive system. The complexity of determining context fit mandates an unconscious process, and our best current understanding of unconscious processing at the

moment is that it be networklike. Therefore, this line of thought predicts that some as yet unrecognized "secondary" network architecture must be able to determine the goodness-of-fit of the "primary" network, which settles into coherent state as a direct consequence of the immediate content of consciousness. Some secondary process must tell us how coherent the primary network configuration is. It has been shown that FOK may have its locus in the frontal lobes (Janowsky, Shimamura, and Squire 1989), and so perhaps the secondary network system is much more in evidence there.

To search for secondary, goodness-of-fit determining networks, of course, neuroscience needs to have some idea what network architectures are able to do the job (a rough and ready version is good enough for now). So, a search for secondary networks in the brain would do well to enlist connectionist computer scientists to work out some likely versions of secondary networks. And perhaps neuroscientist and computer scientist will mutually sharpen one another's ideas if the investigation proves justified.

A final implication of the fringe to be dealt with now touches on the question of the efficacy of consciousness. If the fringe is indeed like a menu bar, then the structure of consciousness *itself* implies that consciousness, qua consciousness, is doing cognitive work, just as it already appears to be. Looking carefully at the function of the fringe provides a new piece of evidence against epiphenomenalism. For in addition to our feelings of undertaking willful action, the functional analysis of the fringe implies that consciousness is equipped with a set of controls that seem to be designed precisely *for* willful action.

Acknowledgments

This paper reports selected findings from Mangen 1991, some of which were presented with

additional supporting evidence in Mangan 1993b,c.

Notes

1. This effect, sometimes called semantic satiation, has been confirmed objectively by many experimental studies going back to [Severance and Washburn \(1907\)](#). See section "Contemporary Research and the Fringe" for further discussion.
2. Later I will extend the notion of the fringe to include certain cases of peripheral and low articulation sensory experiences as treated, for example, by [Rock and Gutman \(1981\)](#). These must not be confused with peripheral and/or low articulation signals that arise from the structure of our perceptual organs (e.g., from the wide receptive fields in the eye). James's discussion of the fringe is limited to nonsensory experience.
3. Theories dealing with an intermediate domain of cognitive processing "below" consciousness and "above" neurons did not appeal to James. For instance, James ridiculed Kant's notion of cognition, calling it (rightly) an "elaborate internal machine shop" (p. 368). Yet of all traditional theories of the mind, Kant's comes closest to the current view of non-conscious processing and its relation to consciousness (see [Bechtel 1988](#) and [Flanagan 1991](#)). [Mangan \(1991\)](#) devotes two chapters to Kant's view of cognition, emphasizing Kant's final position on the constitution and operation of cognitive processes as found in the *Critique of judgement*.
4. This follows Ewald Hering's use of phenomenology to develop hypotheses about specific neural structures (see [Mangan 1993b](#)).
5. All page references without further specification are to the standard pagination of James's *Principles of psychology*; these follow the 1890 edition.
6. James says feelings of relation are "numberless." They range from fringe feelings corresponding to specific logical relations such as "a feeling of *and*, a feeling of *if*, a feeling of *but*, a feeling of *by* . . ." (pp. 245–246) to much more all purpose feelings such as familiarity and rightness. From a cognitive standpoint, the feeling of familiarity is much less important than the feelings of rightness and wrongness. See section "Contemporary Research and the Fringe."

7. James's notion of context was relatively narrow. He held what I would call a "horizontal" view of context: The context for a given experience consists of a set of other past or projected *experiences*. Consistent with his rejection of a Kantian approach to nonconscious processing, James did not seem to hold a modern "vertical" sense of context information as including vast amounts of information processing that never enter consciousness.
8. This point may be key to understanding the cognitive basis and phenomenology of aesthetic experience. [Mangan \(1991\)](#) develops this idea in some detail.
9. See [Mangan 1993a](#) for a brief analysis of consciousness as an information bearing medium and the problems this raises for functionalism.

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